Dr. X's Expertise and Work
By Jennifer Heller Meservey

Dr. X uses computer simulations and mathematical formulas to study how extremely small matter behaves under different conditions. His research can be used to study how single molecules might be used to build much smaller electronic devices. Today's technology continues to decrease in size, but scientists believe that soon these devices will reach a limit at which they cannot shrink any smaller. To resolve this problem, physicists are exploring the possibility of using single molecules to build computer microchips. Dr. X was one of about 100 applicants to be awarded a fellowship by the Center for Materials in order to research this possibility.

Scientists recently experimented with ways to attach molecules to metal wires in order to conduct electricity through them, creating what they called molecular circuits. Through these experiments, scientists found that molecules have electrical resistance, meaning the amount of electricity flowing through them can be controlled. To measure the electrical resistance of these molecular circuits, physicists developed complex algorithms, or numerical formulas, which ran on large computers and consumed massive amounts of resources. The problem with these algorithms was that they were not transparent, meaning it was not easy to understand and control how they worked.

Dr. X developed a simple, transparent formula to measure the electrical resistance of molecular circuits, which was published in E. X. and R. C., D.C. Molecular Wires, Physical Review (2007). When Dr. X tested his formula, he found results which were identical to those of a recent Columbia University study. These results will be published in E. X and R. Car, Tunneling conductance, the Nano Letters. Dr. X has been invited to present his results in Trieste, Italy; at Princeton University's annual Mathematics Department meeting; the annual Recent Developments in Electronic Structure meeting; and two annual American Physical Society meetings.

Dr. X's formula can be used to design much smaller microchips and greatly increase the storage capacity of devices like computer hard drives and smartphones. It can also be used to develop more accurate chemical and biological sensors. These sensors can detect chemical changes and monitor biological processes in people, animals and plants. They have a wide variety of applications, including medical, environmental, safety and security.